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SYNTHESIS AND CHARACTERIZATION OF Ni-Co ON DIFFERENT COMPOSITION SUPPORT TOWARDS HYDROGEN PRODUCTION FROM ACETIC ACID STEAM REFORMING

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Especially to my wonderful wife, who has always been there through the hard times
and to my daughter Sarah

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ABSTRACT

Hydrogen is being considered as an alternative source for power generation in the future. The development of environmental friendly and cost effective hydrogen production become the main challenge in this area. In this work, the production of hydrogen by steam reforming of acetic acid over nickel-cobalt (Ni-Co) supported on lanthanum oxide (La_2O_3), cerium oxide (CeO_2) and aluminum oxide (Al_2O_3) was studied. The objectives of this study are to prepare the catalyst using an impregnation method, to characterize the catalyst using Temperature Programmed Desorption (TPD-NH_3), Brunauer-Emmett-Teller with N_2 (BET-N_2) and Temperature Programmed Reduction with H_2 (TPR-H_2) analysis and also to study the effect of reaction temperature on acetic acid conversion. TPR- analysis of the samples indicated that the amount of hydrogen consumed by the catalyst supported with same oxides decreases with increasing amount of La_2O_3. Furthermore, Ni-Co/70%La_2O_3-20%CeO_2 catalyst was reduced at lower temperature compared to other three catalysts. The result of TPD-NH_3 also showed that the acidity of the catalysts reduced by reducing the amount of ceria. Meanwhile, steam reforming of acetic acid was conducted in a fixed bed reactor with metal catalysts on different supports metal at temperature of 600 ^oC, atmospheric pressure, 0.36 ml/min flow rate, acetic acid concentration 10 wt% and the weight of catalyst was 0.2 g. It was found that the mole fraction of hydrogen over Ni-Co/70%La_2O_3-20%Al_2O_3 catalyst was the highest which is 0.59, while acetic acid conversion over Ni-Co/70%La_2O_3-20%CeO_2 catalyst was the highest 93%. In addition, the catalyst (Ni-Co/70%La_2O_3-20%CeO_2 and Ni-Co/80%La_2O_3-10%CeO_2) performance tests are carried out in a fixed bed reactor at atmospheric pressure and temperature from 500°C to 700°C at increment of 50°C/min, 0.36ml/min flow rate and 10 wt% acetic acid concentration. It was found that the hydrogen production dropped by increasing of temperature and the temperature of 500 to 550^oC produce the high amount of hydrogen.

ABSTRAK

Hidrogen merupakan satu sumber alternatif untuk penjanaan kuasa pada masa hadapan. Pembangunan penghasilan hydrogen yang mesra alam serta efektif dari segi kos merupakan cabaran utama dalam bidang ini. Dalam kajian ini, penghasilan hidrogen melalui proses pembaharuan stim terhadap asid asetik di atas Nikel Kobalt (Ni-Co) disokong pada lantanum oksida (La_2O_3), serium oksida (CeO_2) dan aluminium oksida (Al_2O_3) telah dikaji. Objektif-objektif kajian ini adalah untuk menyediakan pemangkin menggunakan kaedah penyabungan, pencirian mangkin menggunakan analisis-analisis seperti nyahpenyerapan suhu terancang (TPD-NH_3), Brunauer-Emmett-Teller dengan nitrogen (BET-N_2) dan Penurunan Suhu program dengan H_2 (TPR-H_2), dan juga untuk mengkaji kesan suhu tindakbalas terhadap penukaran asid asetik. Analisis TPR ke atas sampel menunjukkan bahawa amaun hidrogen yang disunakan oleh pemangkin tersokong atas oksida berkurangan dengan peningkatan amaun La_2O_3. Di samping itu, pemangkin (Ni-Co/70% La_2O_3-20% CeO_2) diturunkan pada suhu yang lebih rendah berbanding dengan tiga jenis pemangkin yang lain. Keputusan TPD-NH_3 juga menunjukkan bahawa keasidan pemangin-pemangkin dikurangkan dengan pengurangan amaun serium oksida. Sementara itu, proses pembaharuan stim asid asetik telah dijalankan dalam reaktor terpadat dengan penyokong pemangkin logam yang berbeza pada suhu 600 °C, tekanan atmosfera, kadar aliran sebanyak 0.36 ml/min, kepekatan asetik asid sebanyak 10% mengikut nisbah berat dan berat mangkin adalah 0.2 gram. Didapati bahawa pecehan mol hidrogen dengan penggunaan pemangkin Ni-Co/70%La_2O_3-20% Al_2O_3 adalah tertinggi iaitu 0.59, manakala penukaran asid asetik dengan penggunaan pemangkin Ni-Co/70% La_2O_3-20% CeO_2 adalah paling tinggi 93%. Di samping itu, ujian prestasi pemangkin (Ni-Co/70% La_2O_3-20% CeO_2 and Ni-Co/80% La_2O_3-10%CeO_2) dijalankan dalam reaktor laisan tetap pada tekanan atmosfera dan suhu dari 500 ° C sehingga 700 °C pada kenaikan 50 °C/min, kadar aliran sebanyak 0.36 ml/min dan kepekatan asid asetik sebanyak 10% mengikut berat. Adalah didapati bahawa penghasilan hidrogen menurun dengan peningkatan suhu dan penghasilan tertinggi didapati pada 500 ke 550°C.